
Space Weather Technical Forecast

Issued on Monday, 15 January 2024 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of M-class flares throughout.**Analysis of Space Weather Activity over past 24 hours**

Solar Activity: Solar activity is at Low levels, with the largest flare of the period a C9.6 peaking at 14/1206UTC, attributed to Ex-AR3539 beyond the northwestern limb. There are currently twelve sunspots on the visible disc. AR3541 in the southwest has developed slightly, with a number of new spots appearing in the intermediate region. AR3549 still consists of a large leader spot, with trailing spots showing some minor growth and magnetic complexity. Newly numbered AR3555 in the southeast has a secondary spot emerging around the eastern limb, and is now classified as a bipolar region, though analysis of this spot is currently difficult due to foreshortening. All other regions appear to be small or simple.

No CMEs observable on coronagraph imagery over the past 24 hours are expected to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by DSCOVR at L1, have been at background levels. Solar wind speeds have been slow/ambient, between 300-350km/s. Density has been around average or below, though low confidence in this parameter. The interplanetary magnetic field (IMF), Bt, has been weak throughout, at or below 7nT. The north-south component, Bz, was weak and mostly negative, fluctuating between +2/-6nT. Phi angle has fluctuated between positive (away from the Sun) and negative (toward the Sun) throughout, in almost equal amounts. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels, though marginally above the usual baseline due to a minor response from the C9.6 flare from around the western limb at 14/1206 UTC.

GOES16 high energy (greater than 2MeV) electron flux was at background to moderate levels. The associated 24-hour fluence was well below Active ($1e8$ integrated pfu) throughout. The 15/0000 UTC 24-hour integrated fluence observation was $2.01e6$ integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of isolated M-class activity throughout, and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. The high speed stream of CH92/+, with speeds of 450-500 km/s, may arrive day 2 (16 Jan) or into day 3 (17 Jan), with the effects waning into day 4 (18 Jan).

Overall, geomagnetic activity is likely to be Quiet (Kp 0-2), but with a chance of Unsettled to Active (Kp 3-4) intervals days 2 or 3 (16-17 Jan) should we see any HSS influence from CH92/+.

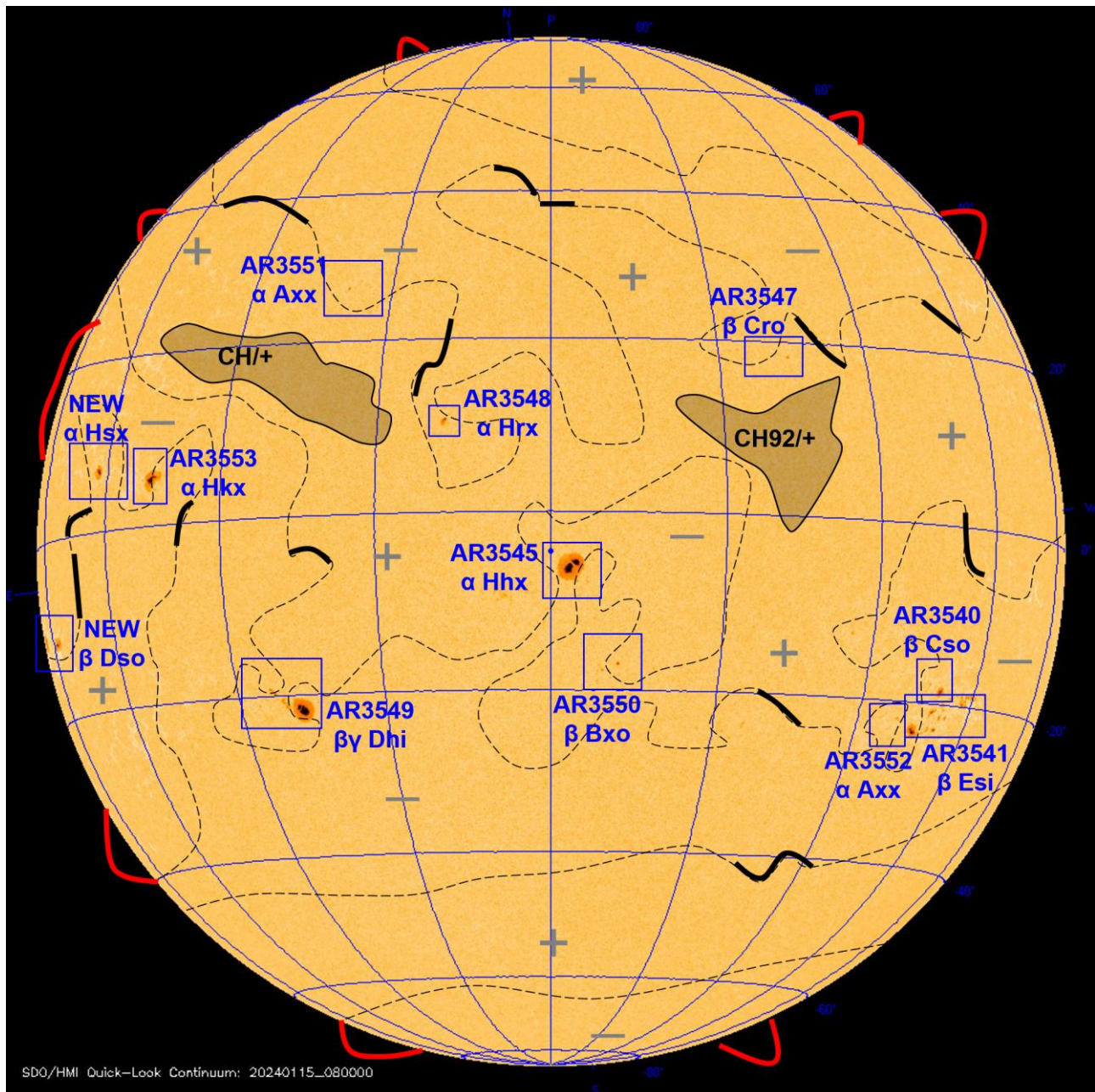
Energetic Particles / Solar Radiation: High energy proton flux will most likely remain at background levels. Although, there remains an ongoing slight chance of seeing an increase to the S1/Minor Radiation Storm threshold, should any notable flares occur.

The high energy electron flux is forecast to persist at background levels, with fluence below

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Active through the period.

Figure 1. Solar Analysis Valid 15/0800 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

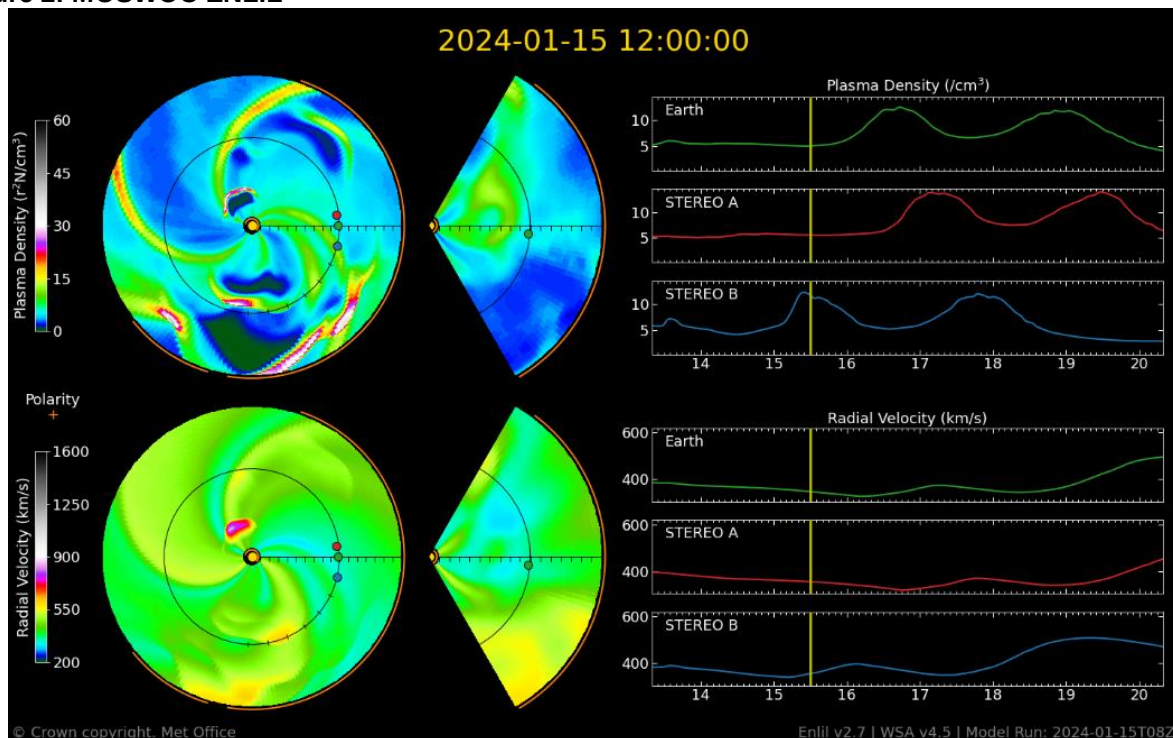
No Earth-directed CMEs feature in the forecast.

Solar wind speeds are expected to remain at slow-ambient levels during day 1 (15 Jan). The main feature of interest in the forecast period is CH92/+, currently in the northwestern quadrant. This coronal hole is a persistent feature, but is smaller and with a leading edge further east than last rotation. Wind speeds in the High Speed Stream (HSS) reached above 600 km/s on the previous rotation, on the equivalent of day 1 (15 Jan). However, the much reduced size of the coronal hole suggests slower wind speeds of 450-500 km/s, which combined with the change in location, gives a potential arrival time day 2 (16 Jan) or perhaps into day 3 (17 Jan).

Overall, geomagnetic activity is likely to be largely Quiet (Kp 0-2). There is a chance of Unsettled to Active (Kp 3-4) intervals from day 2 (16 Jan) upon connection to the anticipated coronal hole HSS.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



Radio Blackouts - X-Ray Flares:

Solar activity is at Low levels. The largest flare of the period was a C9.6 peaking at 14/1206 UTC, appearing to emanate from on or around the northwest limb, probably originating from Ex-AR3538 or Ex-AR3539.

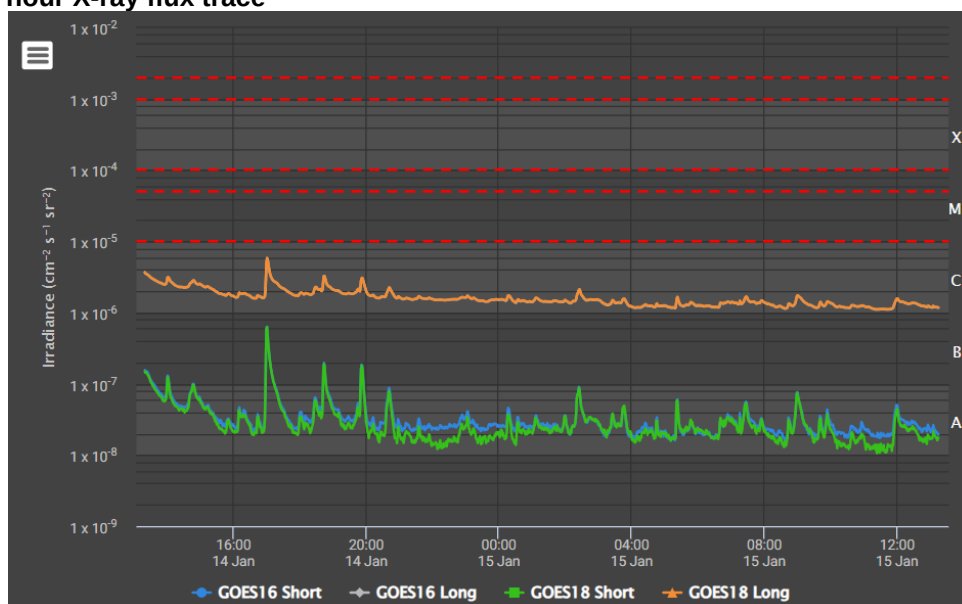
There are currently twelve sunspots on the visible disc, two of which are unnumbered. AR3541 in the southwest has developed slightly over the last few hours, with a number of new spots appearing in the intermediate region. AR3549 still consists of a large leader spot, with its trailing spots showing some minor growth and complexity. The new region in the southeast has a secondary spot emerging around the eastern limb, and is now classified as a bipolar region. Analysis of this spot is currently difficult due to foreshortening. All other regions appear to be stable, or in decay.

Seismic analysis and recurrence would suggest that there are a number of regions which are due to return or rotate across the eastern limb through the period. This is supported by areas of brightness visible on EUVI/AIA 195 imagery suggesting the proximity of Carrington regions.

There is a chance of isolated M-flares throughout, with a slight chance of X-flares, perhaps most probable from the AR3541. This region is expected to rotate around the southwest limb 17 into 18 Jan, with a number of regions possibly rotating onto the disc at a similar time, therefore maintaining a steady flare risk throughout.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: 24 hour X-ray flux trace



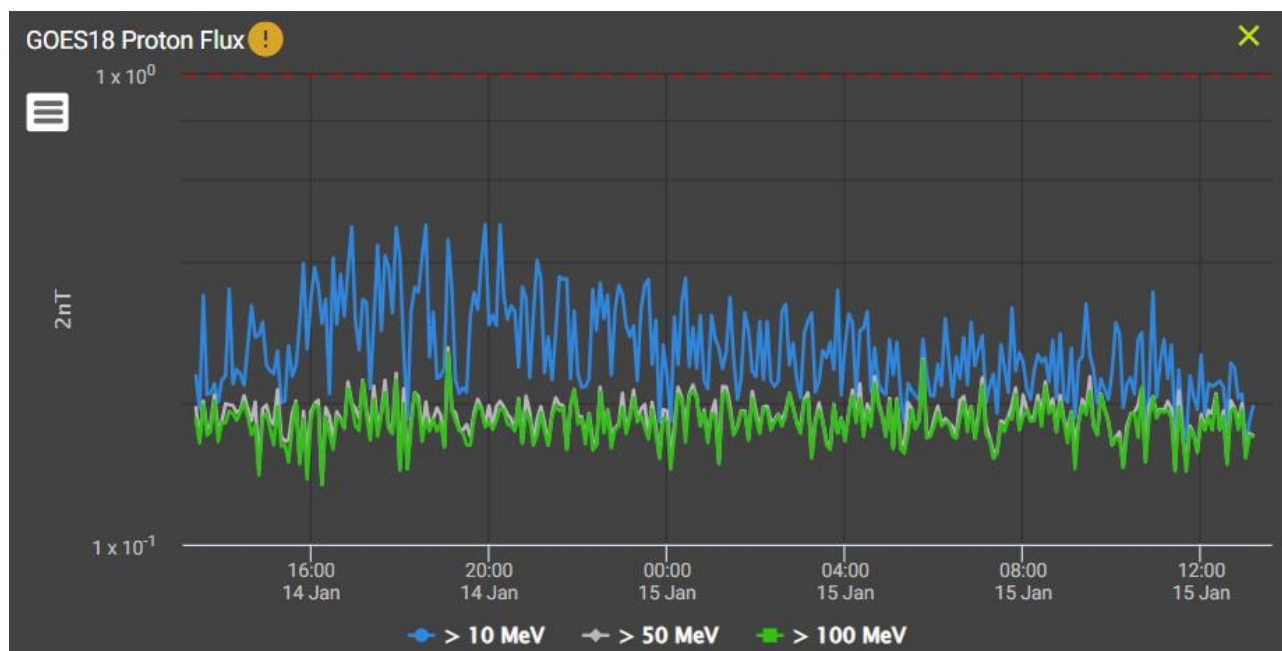
Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is currently at background levels. Any further notable flares will bring a risk of proton flux rising, especially if they occur close to the western limb. Overall, there is a continuing slight chance of reaching the S1/Minor Radiation Storm threshold. With the probability maintained as a number of regions depart, whilst others rotate onto or across the visible disc.

Please note: GOES18 is currently being used as the primary proton instrument, with GOES16 data currently viewed as unreliable due to a fault reported by NOAA.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

Figure 4: 24 hour GOES18 Proton trace showing above background levels in response to C9.6 flare at 14/1206 UTC.



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) as measured by GOES16 at GEO is currently at background levels, and in the absence of any significant enhancement is expected to persist at this level throughout much of the forecast period.

Connection to a coronal hole high speed stream may occur from late day 2 or day 3 (16-17 Jan), persisting until the end of the period, although any associated enhancement is not expected to produce any significant electron response until day 4 at the earliest.

MOSWOC REFM forecast values maintains fluence well below Active throughout the period. This is considered good guidance. Recurrence would suggest fluence values may approach the Active level by the end of day 3 (17 Jan), however, the coronal hole is smaller and less pronounced and further east on this rotation so any enhancement is expected to be less significant and later than on the previous rotation.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM showing observations, forecast and recurrence values for integrated flux/fluence.

